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ARITHMETIC CONSIDERED AS A UTILITARIAN STUDY —WHAT SHOULD BE THE COURSE OF STUDY?

IN preparing this paper two sources have been drawn on: first, the experience of business-men, and, second, the experience of teachers. In using the first source the aim was to secure the business-man's views of our arithmetic as it is taught; and the second source has been used to show the value of the utility idea in teaching arithmetic. The bearing of utility on the course of study has been considered practically and pedagogically.

In working out the business-man's point of view some twenty of the leading business-men of Indianapolis were seen. From most of these we received helpful suggestions, and from only a few, kindly regrets. These men represent many phases of the business world.

The data for the conclusions made in this paper were furnished by men holding such business positions as: president of the State Life Insurance Company, managers of department stores, general manager of the Indianapolis *News*, cashier of the State Bank, president of the Bowen-Merrill Book Co., head agent of the Union Station Ticket Office, president of the D. M. Parry Vehicle Co., head of the office force in the Atkins Saw Works, and head of the Indiana Stationary Co. The following set of questions, accompanied by either a copy of Cook and Cropsey's *Arithmetic* or a table of contents, was left with each of these men:

1. Check such divisions of the table of contents as you consider of no use in business.
2. Indicate the most important subjects in order of their value.
3. Add such other subjects as you believe would be of value to a business-man.
4. Tell us wherein you have found your employees strong in arithmetic and wherein weak.
5. In which do you consider pupils should receive more drill — in oral (mental) or written arithmetic?

6. Give us a summary of what you think schools ought to teach below the high school, and how the teaching may best be made real to the pupils.

The following are representative sets of answers:

I answer question No. 1 as follows: In sec. vi from "surface measure" to the end of the section; in sec. viii from "stock bonds and brokerage" to "interest," inclusive, from "bank discount" to end of section; in sec. x "the cone" to end of section, and all of the appendix—I consider of no value in business.

Question No. 2: The most important subjects in order of their value are, in my estimation, addition, subtraction, multiplication, division, fractions, percentage, ratio.

Question No. 3: I can suggest no other subjects that would be of value to a business-man.

Question No. 4: I find the majority of employees weak in their inability mentally to grasp subjects quickly and with sureness, a lack of confidence in themselves, and a desire to rely upon others rather than solve questions alone. In an arithmetical sense, they are fairly strong in addition and weak in multiplication.

Question No. 5: In mental arithmetic.

Question No. 6: I can suggest nothing that would be of greater value to one intending to enter a business career than systematic, ceaseless training in mental arithmetic. There is nothing to equal mental arithmetic for producing the rapid and accurate solver of most business propositions.

Respectfully,
EDWARD P. CLANCEY,
Manager Wasson's Department Store.

Answer No. 1: The following are not needed in most business transactions:

a) Measurement of the circle.
b) Circular measure.
c) Longitude and time.
d) International date line.
e) Calendar.
f) Life insurance.
g) The so-called "accurate interest."
h) Compound interest.
i) Present worth and true discount.
j) Foreign exchange.
k) Equation of payments.
l) Involution and evolution.
m) The right triangle.
n) Measurement of cones and pyramids.

o) Algebra questions.

Answer No. 2: The most important subjects are about as follows:

a) The four fundamental rules.

b) Fractions—common and decimal.

c) Federal money, bills, and statements.

d) Denominate numbers.

e) Percentage and its applications, as to profit and loss, commission, commercial discount, stocks, bonds, brokerage, insurance, and taxes.

f) Interest, partial payments, bank discount, and exchange.

Answer No. 3: Personal accounts, elements of bookkeeping—single and double entry.

Answer No. 4:

a) Among our employees we find the greatest deficiency in decimals and applications of percentage. In other business institutions a different condition would very likely prevail.

b) In no particular branch have I found them especially proficient.

Answer No. 5:

a) In mental arithmetic.

Answer No. 6: Below the high school all the subjects listed in answer to Questions 2 and 3 should be taught with the utmost care. In addition to these, the elements of mensuration and proportion should be taught, to give pupils some definite ideas of number relations.

To make the subjects in arithmetic real, each one possible should be approached from the concrete side, and following upon this should be an immense amount of mental drill by which the pupil is compelled to do much thinking, talking, and explaining. This process should be faithfully, I might say slavishly, pursued, until speed and accuracy are positively numbered among the pupil's powers. Review! Review!! Review!!!

ANDREW M. SWEENEY,
President Indiana State Life Insurance Company.

In making deduction from the answers received from these business-men one conclusion seems safe, viz., that our arithmetic work is sufficienly extensive. With almost no exception these men have nothing to add to the table of contents, and with equal unanimity, but much greater divergence of opinion, they consider that there have been too many subjects attempted to teach all of them well, and that certain subjects have absolutely no utilitarian value. All of these men are in favor of more drill work on the fundamentals and simpler operations.

Mr. Brown, manager of the Indianapolis *News*, states the case briefly:

> The chief things are the simple things. We find that young men slight the very things essential in arithmetic frequently. Their additions are wrong and their multiplications are full of errors. Everlasting accuracy in these things is what business-men want. The cube root, and all the "fancy" theoretical information, are of no practical value. They are perhaps intellectually advantageous, and as information no doubt elevate the mind; but educate the young fellows to be accurate and know a few things well, if they cannot know all things.

With a single exception, the judgment of all these men is that oral arithmetic should receive the more drill. This opinion seems very emphatic. In answering most of the questions considerable conservatism is shown. But in the matter of oral arithmetic their almost universal judgment is that the return in business utility for time spent in oral arithmetic drill far exceeds that of time used in written work. Mr. Gay, of the New York Department Store, puts the matter as follows:

> We would emphasize very strongly the importance of oral arithmetic. Here you can develop a mental concentration that is seldom acquired in written work. No great mental effort is necessary to solve a simple problem when the figures are on paper. In drilling a class in oral arithmetic a complete mental concentration is necessary for a correct answer. Let the teacher ask an assembled class to give the answer of 7½ yards at 6¾ cents, 2½ at 2⅛ cents, etc.; what is the difference between $4.80 and $3,65; add $4.40 to $6.80; or divide 68 into $3.40.

In answer to the fourth question, "Tell us wherein you have found your employees strong in arithmetic and wherein weak," these men are unanimously silent as to strong points. They have found their employees especially weak in accuracy of addition and multiplication, and ability to handle problems involving decimals and percentage.

Naturally, great division of opinion is found in the answers to the first and second questions. In answer to the first question, "Check such divisions of the table of contents as you consider of no value in business," most men would omit such subjects as measurement of circle, the money of foreign countries, longitude and time, involution and evolution. Many would also strike out cube root and all of the work in the latter part of the arithmetic. Few report factoring of any utilitarian value.

In answer to the second question, "Indicate the most important subjects in order of their value," we find the expected unanimity regarding the prime importance of the fundamental operations, common fractions, and a rather unexpected emphasis on decimal fractions. Next to these percentage is placed in almost every answer. Regarding the applications of percentage, we also find in the answers what we might expect, viz., a wholesome business conservatism regarding the relative importance of these subdivisions. With an insight strikingly pedagogical, in the best sense of that word, these business-men see that the prime utilitarian importance of this or that application of percentage may be determined only by the child's future and present environment. This adaptation of utilitarian arithmetic comes out in the second part of this paper.

In considering the utilitarian arithmetic, as taught by certain teachers, I have endeavored to select only that work which seems adapted to the environment of Indianapolis pupils. We find in Dr. Stanley Hall's *Ideal School* the secret of the special value of the utilitarian point of view in the arithmetic of the upper grammar grades.

If Stanley Hall is right, the time to realize on this crying need for drill work as shown in the reports of these business-men is between the ages of eight and thirteen. If I understand Stanley Hall's theory correctly, between twelve and thirteen the child begins to change from an automatic being into a reasoning, inquiring individual. It would seem that this is the period when the interest in the utilitarian side of life begins to be dominant. If this be true, children in the seventh grade should begin to get the utilitarian point of view.

We have felt that in studying denominate numbers it is well for the 7 B pupils to realize the measuring idea. A discussion of such questions as the following prepare pupils to lay hold of the subject in a broad utilitarian manner.

1. Why do we measure at all?
2. If supply were unlimited, would measuring be necessary?
3. Do we measure in other subjects—in English, in history, etc.?

The following is one pupil's answer to these questions:

ABBIE COOK, 7 B2, 12–2–1901.

MEASURING.

Measuring is a process of finding how many times a unit or a part of itself is contained in the whole. We measure for economy and convenience.

If we had no ways of measuring some people would get more than their share or would pay more for an article than it was worth or not as much as it was worth. Carpenters would buy more material for a house than they would need and they would need very large sheets of paper on which to draw their plans. These would be very inconvenient to carry and to handle and by measuring they can make smaller plans. Every problem in arithmetic contains measuring in some form. Some by measuring distances and others by measuring articles of food.

Surface measuring was taken up with actual computations of schoolroom, yard, etc. The remaining denominate number subjects were worked out in connection with the manual training. The boys built a house to scale. The utilitarian value of lumber measure was immediately apparent, and as the house progressed the need of being able to compute surface measure for lathing, plastering, papering, and carpeting became very real.

The utilitarian value of these divisions of arithmetic is self-evident, and the pedagogical value of presenting them from the utility standpoint became painfully evident when a competent substitute teacher took up the work without the utilitarian point of view.

In the percentage work of the 7 A's a somewhat different problem presents itself. The various applications of percentage are many, and comparatively few of them have a utilitarian value for every pupil. Here also the *scene* of utility changes from the comparatively simple activities of the 7 B work, which concern the home life of practically every child, to the specialized activities of the business-man. How to place the 7 A's in this business atmosphere is the question which confronts the teacher who is considering arithmetic as a utilitarian study. Several schemes have been tried to my knowledge. The one which seems to work best is that of the children imagining a boy compelled to begin work at the end of his grammar-school course. The first few recitation periods are largely given up to working out the plan and following this boy as he applies for and secures a position in a grocery store.

Some of the advantages of selecting the grocery business for this particular class are seen in the facts that fully one-third of the pupils had either parents or near relation in the grocery business, fully one-third of the boys had worked in a grocery store, and all the pupils lived in easy reach of the corner groceryman, of whom they were required to get their knowledge first-hand. The pupils were encouraged to secure order blanks, actual bills of goods, etc., from their grocery adviser. These were mounted, and, together with an account of the boy's experience, make part of a notebook record. The time for working up the notebook record need not all be taken from the arithmetic periods, for the working out of these experiences is interesting and valuable composition drill.

The boy's work of the first day is simple; but the children's boy is always bright and anxious to learn. He is consequently hurried through his first experiences of sweeping, and taking and delivering orders, and is soon sent to the wholesale house to pay a bill. The employer is always kind and allows the boy to foot the bill. The boy finds that the amount given him with which to pay the bill does not equal the footing. The kind employer then leads the boy to see that the bill is being paid within ten days, and a discount is being allowed. From bills secured of grocers, children learn usual discounts and make bills of their own. These bills are footed, but the footing is not placed on the bills. Part of an assignment is to examine the items of a classmate's bill and compute the footing. On returning these bills to the owners there are always some differences in footings. The items are then read by the teacher and computations are made by the pupils as oral arithmetic. The pupils keep the results of the computations for addition.. The items being finished, each pupil adds. After different answers have been reported, it is evident that some are wrong. At this point the pupils readily realize the utilitarian value of drill in addition. Where errors were made, each pupil feels the employer of his boy reproaching him, *i. e.*, reproaching the pupil. The matter is no longer one between the teacher and pupil, but the situation has become that of a business relation. So readily is this transition made from the imagined boy to the pupil himself that in the first week's work pupils had of themselves begun to speak of "Flora's bill," "Thomas's order," etc., and so real does this become that it is expressed in the titles of some of the notebooks, *e.g.*, "My Experience in the Grocery Business." With a class in this condition the teacher may give as long and otherwise tedious columns of numbers for addition drill as he pleases, without any lack of response from even the slowest of girls or the most self-satisfied of boys. The arithmetic is no longer dictation work. The motive is from within.

Boys who seemed on the verge of dropping out of school were caught by this scheme and their whole work improved. One case is particularly worth noting. A boy who had never done anything for anybody became so enthusiastic with his work that not only his arithmetic improved, but also his other work, to such an extent that he was allowed to take 8 B arithmetic in addition to 7 A work.

In the grocery experience may be introduced, besides bills and their discount, interest on overdue bills, gain-and-loss computations, taxes, insurance, commercial discount, and—in a less direct relation—commission.

The utilitarian value of these subjects was made potent by having the boy do his work well a few years and then decide he wished to try the grocery business for himself. He rented part of his employer's store and handled a little stock of flour, brooms, and potatoes. This necessitated his paying part of the expenses. In order to determine the amount of these expenses, each pupil secured a list of running expenses from his grocer. It was then decided that there were still other expenses, one item of which was taxes. This subject was then studied; likewise insurance. The class determined that the boy should rent one-sixth of the store and pay one-sixth of the expenses. After all the above subjects had been studied and the expenses computed, the children asked their groceryman about the selling price of the goods the boy had bought, and made out orders enough to sell all goods. Some might be at a discount to save inventory. After all goods were sold and expenses deducted, many pupils found that they had been doing a losing business, and readily saw the need of careful calculation in business.

In finding the percentage of gain or loss many found themselves lamentably weak in decimal computations. It required no urging from the teacher to get these pupils to do the most grind kind of drill work for getting the decimal point in the right place. They seemed to feel that their employers could not retain them unless they improved. They could hardly have got this feeling except by considering arithmetic as a utilitarian study.

A school bank seems the best means of taking up interest and its applications. Our 8 B's have devoted one period per week to the activities of banking. The result has heen a decided gain in general interest and a rather startling revelation, viz., that, with the organized self-direction among the pupils, two teachers easily assisted seventy-five pupils to teach themselves. The 8 B's organized their part of the school into a city corporation and were paid for service. Money was thus placed in circulation. A place of deposit was needed; a bank was organized; and there soon developed a need of bank books, deposit slips, checks, notes, etc.

Considered as a utilitarian subject, there is little arithmetic left for the 8 A's except review work and a study of mensuration with the algebra point of view. However, it would seem that such subjects as United States revenue, if taught at all to Indianapolis children, should be left until the tariff question is worked out in the 8 A history. It is very difficult for Indianapolis children to realize its utility before such historical study is made. The 8 A seems a fit time for special stress on drill for accuracy which our business friends report so sorely needed. The 8 A pupil should have a rich store of concrete thoughts on all utilitarian subjects. Having this concrete foundation upon which to build the review work, the teacher may legitimately give much time to working for what Mr. Brown, of the *News*, calls "everlasting accuracy."

Considering arithmetic as a utilitarian study, the conclusions from the foregoing, briefly stated, seem to be these: that, on the evidence of business-men, the pupils passing through the schools are deficient in the arithmetic needed in business; that there are some subjects being taught which have no utilitarian value; that oral arithmetic is of much the greater value for business training; that the children of the upper grammar grades are sufficiently developed to get the utilitarian point of view; and that the arithmetic work itself is best taught in its utilitarian setting.

In the light of these deductions, it would seem that the course of study should first lay stress on the fundamentals and such general principles as underlie all business operations, rather than on intricate problems; second, that the course should omit or postpone until the high school such subjects as have no utility in the business world; third, the major amount of drill should be given to such computations as make for proficiency in oral or mental operations; fourth, the course in advanced arithmetic should be adapted to the environment of the Indianapolis pupils and should be sufficiently informal to allow adaptations to the dominant business interests of the pupils of different districts; and, fifth, provisions should be made for surrounding upper-grade pupils with the utilitarian atmosphere of each successive topic studied.

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